DOCUMENT RESUME

ED 253 069 FL 014 750

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TITLE Language Processing and Bilingualism.
PUB DATE [84]
NOTE 19p.
PUB TYPE Information Analyses (070)

EDRS PRI MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Bilingualism; *Code Switching (Language); *Interference (Language); *Language Processing; Language Research; *Linguistic Theory; Literature Reviews; Neurolinguistics; *Neurological Organization

ABSTRACT

Three aspects of language behavior--linguistic independence, linguistic interference, and code-switching, are an integral part of the language processing experiences of the bilingual person. Complex cerebral mechanisms function in a coordinated effort to analyze and synthesize the various components of linguistic codes, store them in semantic representations in one memory, and reproduce them in the language in which the bilingual speaker is expected to communicate in a given situation or context. Aware that they communicate in a sociocultural environment, speakers interact with members of social groups representing two different languages and realize that their linguistic codes are influenced by and permeated with sociocultural elements unique to each language. This is the reality for bilingual persons as they learn to live in and adapt to the changing circumstances of a bilingual bicultural society. (Author/MSE)

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Language Processing and Bilingualism

Juan González

One of the most fascinating areas of current psycholinguistic research is the organization of speech and language in the human brain. The mystery of the functions of cerebral mechanisms in linguistic processing has baffled researchers for years. Recently, with renewed efforts, psycholinguists and neurolinguists have focused their investigations on language processing as it relates to individuals who communicate in two or more languages.

What is language? The late Alexander Luria, prominent Russian researcher on the functions of the human brain, defined language as a system of codes with its own structure and logic created during a long social development. This system of codes

> ...includes a phonology (a system of acoustic and articulatory oppositions which is the foundations of oral speech), a lexicon (a system of designations of objects, actions and relations), a morphology (the structure of words), semantics (which enables us not only to designate objects, actions and relations but to include them in different meaningful systems and correlations), and last but not least, its own syntax (a system sufficient to relate words which are able to formulate thoughts and communications). (1)

These components of the system of codes are analyzed by the coordinated work of the brain's three basic functional units: 1) the upper brain stem and the limbic system; 2) the posterior parts of the brain hemispheres, and 3) the anterior parts of the hemispheres. Together, these units, each playing its own specific role, contribute to the process of acquisition and utilization of linguistic codes influenced by the culture of the speaker.

The brain, then, plays a paramount role in the linguistic

processing by the individual. Available research data on hemispheric lateralization has established that the locus of speech and language is in the left hemisphere of the brain. Studies on the communication activities of individuals who have suffered from aphasia reveal that damage to the left hemisphere of the brain contributes to an impairment of linguistic functions. The extent of the impairment is difficult to determine since one will have to consider several factors such as locus and extent of damage. Patients who undergo neurosurgery are carefully examined and tested by their physician to determine cerebral dominance. This will enable the surgeon conducting the operation to avoid causing any damage to the language centers in the left hemisphere of the brain. (2)

According to Penfield and Roberts (1959), the areas in the left hemisphere critical to speech and language are: Broca's area, Wernicke's area, and the supplemental motor area. (3) Broca's area is situated next to the cortical region of the brain responsible for controlling the muscles of speech. Researchers Edgar Zurif and Sheila Blumstein (1978) conducted a study of patients suffering from Broca's aphasia. Such individuals are victims of lesions to Broca's area and display certain symptoms of linguistic impairment. The findings of the researchers revealed that, though the patients demonstrated relativcly intact comprehension, they used inadequate verbal strategies: substitution of numbers for plural markers, and adverbs of time for tense indicators. Their articulation was somewhat distorted and the use of sentence structure was limited to simple declarative forms. In addition, there was the usual omission of bound and free morphemes and a corresponding

reliance on nouns and , less often, on uninflected verbs. (4)

Another area vital to speech and language production is Wernicke's area. Damage to this section of the brain affects the auditory association cortex of the temporal lobe since it is adjacent to the region receiving auditory stimuli. Though hearing may be normal for the patient, he suffers an impairment in the understanding of spoken and written language. His oral communication is characterized by rapid speech, inappropriate language or utter nonsense. A number of circumlocutions and word substitutions are observed in his speech and the patient may use unrecognizable words. Those who suffer from this type of illness known as Wernicke's aphasia will encounter difficulties with the semantic and syntactic components of language.

Though the left hemisphere of the brain is primarily responsible for the processing of speech sounds, it does not process all auditory signals. Nonspeech environmental sounds are processed in the right hemisphere which is also capable of understanding oral and written language. It is also the hemisphere for visuospatial skills, nonverbal ideation, recognition and memory of melodies, and holistic processing. It is capable of taking over speech and language if the left hemisphere is removed although it may not have the same potential for language specialization as the left hemisphere. (5)

Both the left hemisphere and the right hemisphere complement each other in making it possible for the human brain to process language. It is capable of carrying out this activity

because of the coordinated efforts of its three functional units which can analyze these linguistic codes and synthesize the components of these codes. When the speaker receives information in the form of sensory input provided by a sensory stimulus, he is able to form an image which is an abstraction from reality. The image is a mental representation which the speaker may later wish to communicate to others utilizing certain vocabulary and sentence structures as vehicles of expression. Thus, there is a relation between the mental representation caused by the sensory stimulus and the linguistic means of expressing that image. When the person reacts to a stimulus, his response will require a motor output, that is, the organization, articulation, and expression of the image through a culturally and linguistically acceptable grammatical structure. The structure that develops for linguistic processing and expression of images is the sentence. (6)

Because of its intrinsic nature, an image has a structure which must be inferred from two sources: the language used to form that image and the language used to communicate that image. It is possible to form an image in one language and to express it in another language depending on the cultural experience and language utilization of the individual and the environment in which he finds himself. Such appears to be the case in situations involving bilinguals who speak two languages and partake of two cultures and who may transfer from one sociolinguistic climate to another.

In its task of language processing, the brain utilizes the mechanism of speech perception to isolate units of meaning and at the same time construct relations among these units. The per-

ceptual mechanism operates on actual sentences to extract the units of meaning in sentences and the relations between them. Thus, there is a definite relationship between thought and language so that language structure is somewhat determined by thought, learning, speech perception, and speech production. The sequence of information in the statement or explanation of complex concepts is determined by constraints on sentence structure.

Language processing has two principal objectives: comprehension of the message communicated by the speaker and a subsequent response or reaction by the listener to the decoded message. In the attainment of these objectives, language competence plays a major role. A person's knowledge of the vocabulary, syntax, morphology, and semantics of a language develops somewhat gradually although he possesses some type of competence early in life. A child's competence is somewhat limited so that his comprehension of verbal communication is constrained. However, as he grows, matures, and is exposed to more difficult materials for long periods of time, he is able to increase his basic linguistic competence. This he is able to accomplish through exposure to and acquisition of new and more difficult vocabulary, new meanings, and complex sentence structures, as well as by instruction in understanding and using the dictionary and discussion of content. (7)

It does not suffice, however, for a person to comprehend the linguistic symbols of the words and grammatical structures of a message alone; he must also understand or know various types of information which underlie the message but which has not been explicitly communicated to him. In other words, the speaker assumes

that the listener possesses some general and specific information about the topic being discussed so as to be able to understand it. In his dialogue with the listener, the speaker may want to arrange ideas in a special way, develop a context for the message, or present definitions and referents for the terms employed in the dialogue. The speaker may consider it impractical or unnecessary to convey all the details related to a particular topic; therefore, he limits himself to providing only the relevant details which the situation demands or which he feels the listener will need to appreciate assumptions underlying a particular message. It will be a question of personal judgment and careful evaluation of the circumstances and the presumed knowledge of the listener.

Language processing involves activities in which language behavior is analyzed. Such analysis reveals the existence of three important principles which may be applied to all levels of linguistic processing: a) language is rule governed; b) the units of language are context dependent; and c) the units of language are members of categories. Every language has rules which govern the order in which the various linguistic units are placed together. In addition, many speech sounds, words, and sentences depend on context for their interpretation. The fact that speech sounds are dependent on context indicates that a particular sound pattern will be heard differently in a multiplicity of sound-pattern contexts. Finally, speakers of a language perceive units of speech as members of categories and when they use a particular word, they are symbolizing a category of events or relationships. (8) These

three principles of language behavior - rules, context dependency, and categorization - are applicable to the processing of words, sentences and messages.

In the task of language processing, the listener hears a word or strings of words in a sequential order. He will endeavor to process a part of a clause or sentence first and then its subsequent parts. As he is involved in this process, he conveys meanings to words and simultaneously analyzes their syntactic structure and semantic relations. Thus speech is segmented or broken up into small chunks and then it is integrated. This pattern of speech processing is learned from infancy and its development continues and manifests itself in the strategies used by preschool children with respect to word order in sentence comprehension.

Lempert and Kinsbourne (1980) conducted a study with 52 children ages two years and five months to six years and three months who were required to act out the meaning of reversible passive and inverted cleft sentences. The active and cleft sentences were used by the researchers as standard order controls designed to permit the child to focus his attention on sentence structure. The findings of the study indicated that the approach used by young children in dealing with word order was varied, and that it changed with age. Older and younger children recorded information about word order in the sentence processed and both groups could transform word order. Older children demonstrated a greater awareness than younger children when an inappropriate approach presented itself. The researchers concluded that:

> young children are more likely than are older children to apply the same routine approaches to a variety of structures.In some cases, this may even result in young children showing better comprehension of a structure than older children. Older children...are more flexible in how they apply strategies...for sentence processing. So by using whatever strategies are available to them, young children bypass the need for intensive structural analysis.(9)

In his study "New Models in Linguistics and Language Acquisition", Maratsos (1978) refutes the generally held theory about language acquisition that children adopt a strict word order to communicate logical relations. He cites recent studies by Park (1970) and Slobin (1975) which reveal that children learning German and Turkish employed free word order in their syntactic structures. (10)

During the past twenty years, psycholinguistic research has devoted considerable attention to language processing and bilingualism.Numerous studies have been conducted on various aspects of language acquisition and development in the bilingual child and adult. The bilingual possesses two distinct linguistic systems capable of functioning independently or interdependently according to the situations in which he is called to perform. Some researchers distinguish between a compound bilingual and a coordinate bilingual. The compound bilingual acquires two languages in a joint context; he learns a set of concepts, each with linguistic labels in each of the languages he has learned. Such an individual may have acquired both languages in early childhood when he utilized them interchangeably in communicating with others who used these languages. He may have also learned one language first and then the

second language within the context of the first language. This may have been accomplished through the translation and association of the lexical items of the second language to words and concepts of the first language. (11)

The coordinate bilingual, on the other hand, acquired languages in different contexts; that is, he learned his first language in a context different from that of his second language. Words which have been translated as equivalents refer to different concepts in the two cultures. As Gekoski observes: "...the coordinate bilingual, acquiring lexical items in the second language in conjunction with the relevant concepts in the second culture, develops two sets of verbal labels, each tied to its respective conceptual system." (12)

Though some researchers may not consider the distinction between a compound bilingual and a coordinate bilingual an important one, Macnamara (1967) observes that the reason for the distinction is threefold: (1) the implications of the effect of acquisition on the semantic aspects of language; (2) the attention given to cultural differences between language settings and to the possibility of cross-cultural misunderstandings; and (3) it enables one to understand how coordinate bilinguals manage to keep their languages from becoming mixed up. (13)

Three aspects of bilingual language behavior are linguistic independence, linguistic interference, and code switching. Linguistic independence relates to the ability of the bilingual speaker to maintain the two languages separate and not to mix them up. Many bilinguals demonstrate a knowledge of the sound system, the vocabulary,

and the sentence structures of both languages and can communicate in either language without interference from the other language. This linguistic independence may be explained by a theory presented by Penfield and Roberts (1959) which states that there is a functional separation of the neurological systems underlying the two languages of bilinguals. A single switch system controls the language that is "on", that is, that the speaker is using, and keeps the second language "off".

Linguistic independence raises a question concerning the organization and storage of linguistic units in the brain of the bilingual. Are the two language systems of the bilingual organized independently or as interdependent units? Various techniques such as word association, free recall, paired-associate learning, recognition memory, reaction time, and interference in the Stroop color-naming paradigm have been used by researchers who have reported findings supportive of both interdependent and independent organizations of linguistic storage. Gekoski (1980) compared the performance of compound and coordinate bilinguals in intralingual (stimulus and response in the same language) and interlingual (stimulus in one language, response in the other language) word association tasks. The criteria used for the selection of the interlingual pairs of word association stimuli were: 1) they were judged to be translation equivalents; and 2) the responses to these words given by monolingual speakers of the respective languages were not translation equivalents. The author concluded that:

> The present findings are consistent with a broader, continuum notion of conceptual and linguistic separation in bilinguals;bilinguals can

> be considered more or less compound or coordinate depending upon what proportions of their linguistic and conceptual repertoires are so organized. (14)

Factors other than those related to language acquisition context would need to be considered in order to determine an individual's place in the compound-coordinate continuum.

Linguistic independence is part of the language processing activities of the bilingual speaker. Volterra and Taeschener (1977) studied the simultaneous acquisition of language by bilingual children exposed almost equally to the two languages from birth. Language learning took place in the environment of the home as one of the parents spoke one language to the children while the other parent communicated with them in the second language. The results of the study suggested to the researchers the existence of three stages in the learning process of the bilingual child. In stage I, the child demonstrates one lexical system comprising of words from both languages. Two and three word constructions include vocabulary from both languages, and it is somewhat difficult, if not impossible, to make any appropriate evaluation of the child's sentence structure. His use of a particular language will depend on what he wishes to communicate. Another observation made at this stage is that a word in one language does not always have a corresponding word with the same meaning in the second language.

In stage II, the child demonstrates a knowledge of two different lexicons so that he is able to identify the same object with two different words pertaining to two different languages. With respect to the utilization of grammatical structures, the child applies the

same syntactic rules to the two languages. At times the use of a particular word in a given language versus the use of a similar word in the second language is determined by the situational and pragmatic conditions in which the word was learned.

In stage III, the child is able to communicate in two languages which he has differentiated both in vocabulary and syntax. In addition, he is able to identify and associate each language with the person utilizing that language. (15)

The second aspect of language behavior mentioned earlier is linguistic interference. This may be defined as the intervention of the sound system, vocabulary, syntax, and semantic system of one language on those of another. This linguistic phenomenon appears rather frequently in communities where two languages are in contact with each other. Linguistic interference occurs among children and adults alike. Children sometimes learn a language which is a mixture of two languages, and the brain will process this linguistic input regardless of its composition and its source. Lindholm and Padilla (1978) studied language samples of Spanish-English bilingual children between the ages of 2 years, 10 months, and 6 years, 2 months, for language mixing. They cited examples of the use of masculine and feminine indefinite articles with English nouns: "Hizo una birthday"; "Tiene un pony chiquito". They also provided samples of sentences using either the feminine or masculine demonstrative adjective: "Mamá, me da de ese carrot", "Ahora vamos a arrancar estos candies". The researchers concluded that:

> bilingual children employ language mixes either when they lack the lexical entry in the appropriate language or when the mixed entry is more salient to the child. The mixes are predominately English nouns inserted into Spanish utterances. Further, when these mixes occur, the structural consistency of the utterance is maintained. (16)

González (1978) studied the development of Spanish phonology and grammatical patterns in Spanish-speaking children between the ages of two and five. Though his purpose was not to study language mixing, he recorded speech samples of children in which there is evidence of language interference: "Quero (quiero) colors."; "Mía (mira), ahí tiene su coke"(age 2) and at age 3.3, one of the samples recorded reads: "Me compró un shoe mi mamá. (17)

Redlinger and Park (1980) examined language mixing in relation to overall linguistic growth patterns in the speech development of four two-year old children growing up in a German speaking community. The researchers focused on making a systematic analysis of language mixing with respect to linguistic development in terms of age or MLU (Mother's Language Usage). The subjects of the study were children of German fathers and non-German mothers. Two of the children were bilingual in French and German; one was a Spanish-German bilingual, while the fourth child was an English-German bilingual. The length of time devoted to the study varied from five months to nine months. Language mixing by the children revealed that there was a rather high rate of mixing of the languages at the beginning. However, this decreased with a growth in language development as measured in the MLU. Observed on an individual basis, each child demonstrated a degree of mixing which appeared to have

been influenced by both linguistic and sociolinguistic factors. There are recorded examples of mixing German and Spanish: "Putzen Zähne con jabón." ('Brushing teeth with soap.');"Manzanas. Hund schlafen." ('Apples. Dog sleeping.') Sentences in which there was evidence of language mixing in English/German and in French/German were also documented. According to the investigators, the mixing rates of the four children decreased with their gradual linguistic development. In the early stages of development, the rates of mixing the languages were lower than those at later stages. Redlinger and Park concluded that "the subjects were involved in a gradual process of language differentiation and are in agreement with those of previous investigators supporting the one system approach to bilingual acquisition." (18) Lexical substitutions by parts of speech showed that children preferred to substitute nouns more frequently, and that more function words were substituted than content words.

The third aspect of a bilingual's linguistic behavior is code-switching which may be defined as the speaker's ability to switch from one language to the other. Macnamara (1967) discussed this aspect of the bilingual's language processing behavior. Concerned with the time factor in code-switching, he wondered how a bilingual was able to use a word or phrase from his other language. He explained it thusly: "The most likely explanation is that he has the capacity to activate the L_2 system, carry out the semantic encoding, the selection of words and the syntactic organization while more or less mechanically producing in L_1 material which has already been prepared for production." (19) This goes hand in hand with the researcher's belief in the hypothesis of language

independence which affirms that the bilingual person possesses different memories isolated from one another. Translation processes permit interaction between them.

In contrast to the independence hypothesis, other researchers have found evidence to support the existence in bilinguals of only one memory store where some information was limited to the language of encoding while other information was accessible in both languages. This interdependence hypothesis has received support from a study by Mägiste (1979) dealing with the developmental changes in the decoding and encoding processes of 163 Swedish German bilingual students living in Sweden. According to the investigator, the decoding activity in two languages, stated in terms of reaction time, develops faster than the encoding activity. The longer response times recorded by the bilingual subjects were evidence of the interdependence hypothesis of bilingual storage. Because the bilingual subjects stored words in memory through semantic representations, recall and production of these words activate the semantic representations in memory. As Mägiste observed: "...bilinguals (multilinguals) have a single conceptual code and accessing this code makes available more perceptual codes than are available for the monolingual leading to longer response items." (20)

The three aspects of language behavior previously discussed - linguistic independence, linguistic interference, and code-switching - are an integral part of the language processing experience of the bilingual person. Complex cerebral mechanisms function in a coordinated effort to analyze and synthesize the various components of

linguistic codes, store them in semantic representations in one memory, and reproduce them in the language in which the bilingual speaker is expected to communicate in a given situation or context. Aware that he communicates in a sociocultural environment, the speaker interacts with members of social groups representing two different languages and realizes that his linguistic codes are influenced by and are permeated with sociocultural elements unique to each language. This is the world of reality for the bilingual as he learns to live and adapt to the changing circumstances of a bilingual bicultural society.

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